DIRECTORATE FOR BIOLOGICAL SCIENCES (BIO) $733,860,000 +$21,480,000/ +3.0%

Biological Sciences Funding

(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate Amount	Percent
Molecular and Cellular Biosciences MCB)	$123.93	$125.79	$132.68	$6.89	5.5%
Integrative Organismal Systems (IOS)	212.56	212.33	220.52	8.19	3.9%
Environmental Biology (DEB)	142.72	142.56	143.73	1.17	0.8%
Biological Infrastructure (DBI)	129.28	126.18	129.68	3.50	2.8%
Emerging Frontiers (EF)	103.79	105.52	107.25	1.73	1.6%
Total, BIO	**$712.27**	**$712.38**	**$733.86**	**$21.48**	**3.0%**

Totals may not add due to rounding.

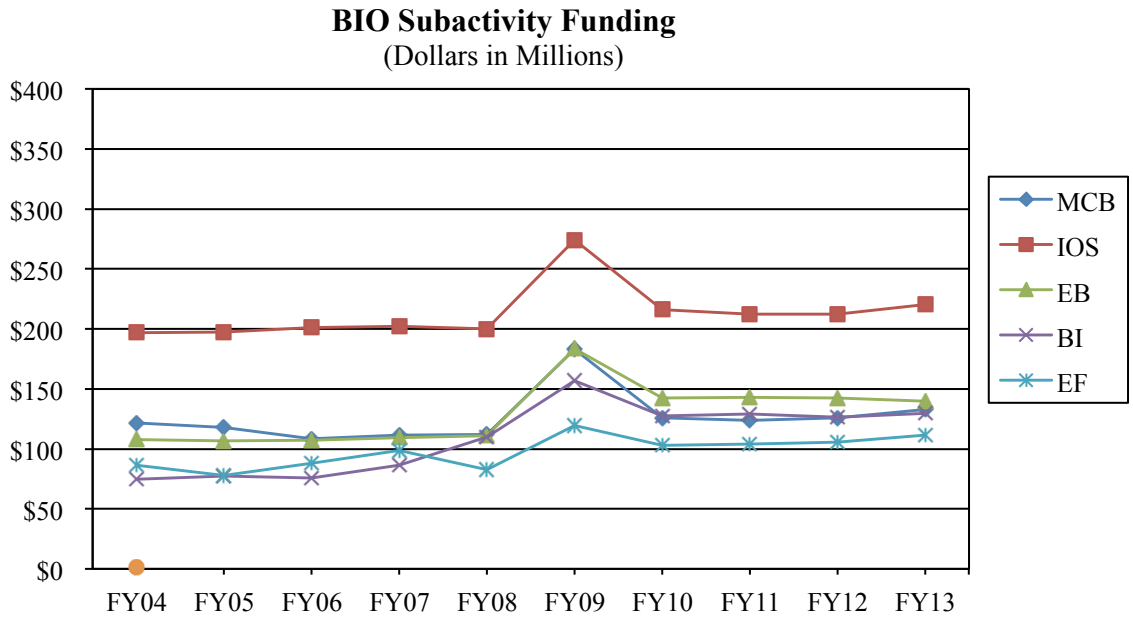
About BIO

BIO's mission is to enable discoveries for understanding life. Through investments in innovative and transformative research, BIO advances the frontiers of knowledge in the life sciences by increasing our understanding of complex living systems. BIO-supported projects also provide the theory, data, and other research resources that advance research in other science and engineering fields. These fields are adapting and employing principles and processes derived from biological systems to answer fundamental questions, develop practical applications, and solve problems.

Issues of national importance related to the environment, economy, agriculture, and human welfare require an understanding of how complex living systems function and interact with each other and with non-living systems. Research supported by BIO enhances this understanding. As the physical, computational, mathematical, and engineering fields increasingly use living systems to address their major questions, NSF's robust investment in the non-medical biological sciences becomes increasingly relevant to tackling these multidisciplinary challenges.

Biological concepts are integral to wide-ranging areas of science essential to human welfare and the bio-economy, including national priorities such as climate science, biotechnology, and bioengineering. Over the last 3.5 billion years, living organisms have evolved mechanisms for efficiently using energy, producing an endless array of novel compounds, and storing information in a highly compact, adaptable format. Fundamental biological research makes these innovations available to inform the next generation of nano-, bio-, and information technologies. For example, research funded through a BIO CAREER award recently showed that simple and efficient algorithms can be developed using insights derived from discoveries about how a nervous system develops. BIO's investment portfolio includes projects on understanding the changing dynamics of the biosphere, research on the fundamental characteristics of biological energy systems, and efforts to broaden participation and develop the next generation of biological researchers.

BIO provides about 62 percent of federal funding for non-medical, basic research at academic institutions in the life sciences, including environmental biology, a research area critical for addressing questions related to climate science.



FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided though the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

FY 2013 Summary by Division

- BIO's FY 2013 Request prioritizes contributions to the OneNSF Framework through support for innovative, interdisciplinary activities including Innovation Corps (I-Corps), INSPIRE, Science Engineering and Education for Sustainability (SEES), Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21), Expeditions in Education (E^2), and Cyber-enabled Materials and Manufacturing and Smart Systems (CEMMSS). BIO also focuses investments on research to address the five Grand Challenges in Biology: synthesizing life-like systems; understanding the brain; predicting organisms' characteristics from their DNA sequences; elucidating interactions between the earth, its climate and its biosphere; and understanding biological diversity (2010 National Research Council report, "Research at the Intersection of the Physical and Life Sciences"). In addition, BIO's enhanced support for Research at the Interface of Biological and Mathematical and Physical Sciences and Engineering (BioMaPS) advances the knowledge frontier and bolsters the foundation of the OneNSF Framework.

- MCB's FY 2013 requested increase of $6.89 million, or 5.5 percent, is focused on support for fundamental research to understand the dynamics and complexity of living systems at the biochemical, molecular, and cellular level, which is important foundational research at the heart of the grand challenges. In addition, MCB will enhance support for BioMaPS. This interdisciplinary effort, in collaboration with MPS and ENG, will result in accelerated understanding of biological systems, leading to innovations in manufacturing in such areas as renewable fuels, bio-based materials, bio-imaging, and bio-inspired sensors. MCB will also fund advanced manufacturing through the CEMMSS activity and its breakthrough materials component. An example of the MCB-relevant research includes computational mining of the genomic data from diverse biological systems to identify inspirations for the design and synthesis of new materials with defined properties and

capabilities, and predictive synthetic biology to design new nanomaterials, particularly based on photosynthesis and other biological processes.

- IOS's FY 2013 requested increase of $8.19 million, or 3.9 percent, is aimed at fundamental research on organisms as complex integrated systems, and their interactions with their social and physical environments especially as they adapt to climate variability and other environmental factors. IOS also maintains its commitment to support for fundamental plant genome research. The activities of the Plant Genome Research Program (PGRP) support genome-scale research to accelerate discoveries about basic plant biology, as well as downstream applications of societal benefit such as crop improvement, new sources of bio-based energy, and development of novel bio-based materials. IOS participation in BioMaPS and the BIO Five Grand Challenges are important components of these activities. One of the grand challenges, understanding the brain, will be supported through enhanced activity in the neurosciences.

- DEB's FY 2013 increase of $1.17 million, or 0.8 percent, will sustain research on complex ecological and evolutionary dynamics to improve our ability to understand the reciprocal interactions between living systems and the environment, and inform essential considerations of environmental sustainability. To allow for enhanced support for SEES and the BIO Five Grand Challenges, the Assembling the Tree of Life (AToL) program will be moved towards a biennial competition from an annual. DEB programs provide essential research support towards understanding the grand challenge questions regarding interactions of the earth, its climate and biosphere the environmental link between genotype and phenotype, and understanding biological diversity. Enhanced support is provided to continue international partnerships with Brazil and China related to the Dimension of Biodiversity program activity.

- DBI's FY 2013 requested increase of $3.50 million, or 2.8 percent, empowers biological discovery by supporting the development and enhancement of biological research resources, human capital, and centers. It also reflects funding for the OneNSF investment, Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21) through support for the Software Infrastructure for Sustained Innovation program (SI2). To allow for enhanced support for CIF21 and the BIO Five Grand Challenges, the Collections in Support of Biological Research program will be moved towards a biennial competition from an annual. Infrastructural support either through research resources, centers, or support of STEM activities is essential to all priority activities in OneNSF or BIO Grand Challenges science support.

- EF's FY 2013 requested increase of $1.73 million, or 1.6 percent, enhances support for developing priorities and increases the National Ecological Observatory Network (NEON) infrastructure investment. In FY 2013, support includes: focused activities within SEES; continued coordination of cross-directorate innovation activities, including INSPIRE and I-Corps; and oversight of Transforming Undergraduate Biology Education (TUBE). Enhanced support for BioMaPS in MCB and IOS will be matched by continued investments from EF. Funding for TUBE will be decreased and support in these areas will be redirected towards the developing Expeditions in Education in an effort to integrate support across Research and Related Activities (R&RA) within NSF. NEON concept and development (C&D) and early operations and maintenance (O&M) will be supported through EF. As NEON enters year three of construction, operations will be enhanced as more sites and domains go on-line, providing a continuous stream of data and access broadly to the science community. Continued C&D will be used for advanced tool development and educational programming in FY 2013.

Major Investments

BIO Major Investments

(Dollars in Millions)

Area of Investment	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate Amount	Change Over FY 2012 Estimate Percent
Advanced Manufacturing	-	$2.00	$2.60	$0.60	30.0%
BioMaPS	5.57	9.00	13.57	4.57	50.8%
CAREER	32.70	31.13	32.63	1.50	4.8%
CEMMSS	-	3.00	5.00	2.00	66.7%
CIF21	-	2.00	4.00	2.00	100.0%
Clean Energy Technology	35.75	39.00	45.00	6.00	15.4%
E^2	-	-	2.00	2.00	N/A
I-Corps	0.05	0.50	2.00	1.50	300.0%
INSPIRE	-	2.00	4.00	2.00	100.0%
SEES	24.59	27.25	34.75	7.50	27.5%
BIO 5 Grand Challenges	-	-	20.00	20.00	N/A

Major investments may have funding overlap and thus should not be summed.

- Advanced Manufacturing: BIO will provide $2.60 million in advanced manufacturing through support for research as part of BioMaPS and CEMMSS. Both investments are described in more detail below.

- BioMaPS: Research at the Interface of Biological, Mathematical and Physical Sciences Engineering (BioMaPS) seeks to discover fundamental new knowledge to enable innovation in national priorities such as clean energy, climate science, and advanced manufacturing. This interdisciplinary interface is fertile ground for new technologies than can address societal problems through predictive modeling and disruptive solutions in biotechnology and could lead to new industry that is inspired by biology. In FY 2013, BIO will increase support by $4.57 million for a total of $13.57 million.

- CAREER: BIO's CAREER awards support young investigators who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations. In FY 2013, BIO will increase support for CAREER by $1.50 million for a total of $32.63 million. This will support approximately 235 awards in FY 2013.

- CEMMSS: BIO support will enable breakthrough materials through research on topics such as computational mining of genomic data from diverse biological systems to identify inspirations for design of new materials; or predictive synthetic biology to design new nanomaterials, particularly based on photosynthesis and other biological processes. BIO will invest $5.0 million in this activity.

- Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21): BIO support for CIF21 (+$2.0 million to a total of $4.0 million) will focus on software infrastructure for sustained innovation and data-enabled science.

- Clean Energy Technology: BIO support for clean energy technology (+$6.0 million to a total of $45.0 million) occurs through support for fundamental research in programs such as biomolecular systems, photobiology, genetic engineering and metabolic biochemistry with relevance in areas such as fuel cells, hydrogen, and biomass and other energy efficiency and use.

- Expeditions in Education (E^2): BIO will initiate investment ($2.0 million) in this new OneNSF investment, which seeks to generate a stronger and more deliberate infusion of cutting-edge science, engineering, and innovation into programs aimed at preparing a world-class science workforce.

- I-Corps: BIO will support ($2.0 million) I-Corps grants to test the feasibility of commercial prototypes developed from NSF/BIO-supported research.

- INSPIRE**:** BIO will provide support (+$2.0 million to a total of $4.0 million) to co-fund larger cross-disciplinary grants that embody unusually creative high-risk / high-reward research.

- Science, Engineering, and Education for Sustainability (SEES): SEES coordinates and enhances research and education on the environment, energy, and sustainability. BIO will enhance support for Sustainability Research Networks (SRNs) and Coupled Natural and Human systems (CNH). Other programs will be maintained, including SEES Fellows, Dimensions of Biodiversity, Research Collaboration Networks (RCN) and research on ocean acidification. In FY 2013, BIO increases investment in this activity by $7.50 million, to a total of $34.75 million.

- BIO Five Grand Challenges: 21st Century biology must provide the knowledge needed to understand living systems and the role of the living world in shaping and adapting to a changing planet. The comprehensive grand challenges described in the 2010 NRC report are envisioned as the way to create opportunities for innovative research. BIO will prioritize a focus across all divisions ($20.0 million total) on research relevant to the five grand challenges: synthesizing life-like systems; understanding the brain; predicting organisms' characteristics from their DNA; interactions of the earth, its' climate and its biosphere; and understanding biological diversity.

BIO Funding for Centers Programs and Facilities

BIO Funding for Centers Programs

(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate Amount	Change Over FY 2012 Estimate Percent
Centers Programs Total	**$39.06**	**$42.22**	**$42.40**	**$0.18**	**0.4%**
Centers for Analysis & Synthesis (DBI)	22.94	26.12	26.30	0.18	0.7%
Nanoscale Science & Engineering Centers (DBI)	5.12	5.10	5.10	-	-
Science & Techology Centers (DBI)	9.00	9.00	9.00	-	-
Science of Learning Centers (DBI)	2.00	2.00	2.00	-	-

For detailed information on individual centers, please see the NSF-Wide Investments chapter.

- Centers for Analysis and Synthesis: Funding increases by $180,000 over the FY 2012 Estimate, to a total of $26.30 million. The program will support four centers in FY 2013. The increased support represents annual increments including support for the new National Socio-Environmental Synthesis Center (SESynC) established in FY 2012.

- Nanoscale Science and Engineering Centers (NSEC): Support will be maintained at $5.10 million for the Center for Environmental Implications of Nanotechnology (CEIN).

- Science and Technology Centers (STCs): Support will be maintained at $9.0 million for two STCs; Science and Technology Center for Microbial Oceanography Research and Education (C-MORE) and Bio/computational Evolution in Action CONsortium (BEACON).

- Science of Learning Centers: Support will be maintained at $2.0 million.

BIO Funding for Facilities

(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate Amount	Change Over FY 2012 Estimate Percent
Facilities (Total)	**$10.02**	**$23.28**	**$33.74**	**$10.46**	**44.9%**
Nanofabrication (NNIN)	0.35	0.35	0.35	-	-
National Ecological Observatory Network (NEON)	9.67	22.93	33.39	10.46	45.6%

For detailed information on individual facilities, please see the Facilities chapter.

Summary and Funding Profile

BIO supports investment in core research and education, as well as research infrastructure such as NEON and iPlant ($12.0 million, level with the FY 2012 Estimate)..

In FY 2013, the number of research grant proposals is expected to increase by 360 compared to the FY 2012 Estimate and BIO expects to award about 1,020 research grants. Average annual award size and duration are not expected to materially fluctuate in FY 2011 through FY 2013.

In FY 2013, BIO will invest $42.40 million for centers, accounting for 5.8 percent of the BIO budget. Centers are an important modality for biosciences, since research in many BIO-supported disciplines has evolved to be more collaborative and interdisciplinary.

Operations and maintenance funding for BIO-supported user facilities comprises 4.6 percent of BIO's FY 2013 Request. BIO has increased the operations and maintenance budget for NEON consistent with the planned ramp-up of operations as construction continues as scheduled.

BIO Funding Profile

	FY 2011 Actual Estimate	FY 2012 Estimate	FY 2013 Estimate
Statistics for Competitive Awards:			
Number of Proposals	7,440	7,640	8,000
Number of New Awards	1,311	1,350	1,440
Funding Rate	18%	18%	18%
Statistics for Research Grants:			
Number of Research Grant Proposals	6,431	6,570	6,880
Number of Research Grants	982	985	1,020
Funding Rate	15%	15%	15%
Median Annualized Award Size	$173,904	$185,000	$185,000
Average Annualized Award Size	$226,246	$230,000	$230,000
Average Award Duration, in years	3.2	3.1	3.1

Program Monitoring

The Performance Information chapter provides details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees. Please see this chapter for additional information.

Committees of Visitors (COV):

- In 2011, COVs reviewed Molecular and Cellular Biosciences division (MCB) and Integrative Organismal Systems division (IOS). The COVs presented their reports to the BIO Advisory Committee, which convened in April and December of 2011. Recommendations included: develop grand challenge foci; continue efforts to collaborate both within NSF and across agencies; provide clearer instructions to reviewers on broader impacts; and provide information on balancing the portfolio, including impacts of breadth versus depth.
- In 2012, COVs will review the Environmental Biology (DEB) division and the Office of Emerging Frontiers (EF).
- In 2013, a COV will review the Biological Infrastructure (DBI) division.

Workshops and Reports:

- A number of recent workshops and reports have informed programmatic portfolio development. The workshop, held on January 6-7, 2011, "Research Frontiers in Bioinspired Energy: Molecular-level Learning from Natural Systems," was sponsored by NSF and the Department of Energy (DOE), and was jointly organized by the National Academies of Science (NAS) Boards on Life Sciences and Chemical Sciences and Technology. Its focus was to explore the molecular-level frontiers of energy processes in nature.

  The 2010 NAS report, *Research at the Intersection of the Physical and Life Science*, has informed the development of two major emphases: the BioMaPS program beginning in FY 2011 and continuing and expanded in FY 2013; and the new BIO Five Grand Challenges in Biology activity. Other workshops that have shaped the BIO grand challenge activity have included: How Molecules Come

to Life: Biophysics Vision (2011) and Phenomes – Beyond Genomes (April 2011).

Several workshops informed the BIO involvement in CIF21: NSF-Workshop on Creating Scientific Software Innovation Institutes for the Environmental Observatory Communities (October 2010); Data-Intensive Sciences Workshop I and II (September 2010 and May 2011); Cyberinfrastructure for Collaborative Science (May 2011).

Other workshops continue to help frame the Dimensions of Biodiversity program (a SEES activity) and the Digitization program in BIO. Those include: Digitization Workshop on Best Practices Development Session (April 2011); Dimensions of Biodiversity Charrette (September 2010); and Fostering Brazil-USA Scientific Exchange through Dimensions of Biodiversity (July 2011).

Science and Technology Policy Institute (STPI) Reports and Evaluations:

- In FY 2010, BIO initiated a STPI study to assess the need for and feasibility of evaluation of the impact of support for plant genome research programs. A final report of this study is currently in preparation for expected delivery early in 2012.

Number of People Involved in BIO Activities

	FY 2011 Actual Estimate	FY 2012 Estimate	FY 2013 Estimate
Senior Researchers	6,871	6,890	7,000
Other Professionals	1,784	1,800	1,875
Postdoctorates	1,546	1,560	1,640
Graduate Students	2,878	2,900	3,100
Undergraduate Students	4,601	4,630	4,760
K-12 Teachers	-	-	-
K-12 Students	-	-	-
Total Number of People	**17,680**	**17,780**	**18,375**

DIVISION OF MOLECULAR AND CELLULAR BIOSCIENCES (MCB) $132,680,000 +$6,890,000 / 5.5%

MCB Funding
(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate Amount	Percent
Total, MCB	**$123.93**	**$125.79**	**$132.68**	**$6.89**	**5.5%**
Research	**122.68**	**124.56**	**131.45**	**6.89**	**5.5%**
CAREER	*13.38*	*12.74*	*13.35*	*0.61*	*4.8%*
Education	**1.25**	**1.23**	**1.23**	**-**	**-**

Totals may not add due to rounding.

MCB supports fundamental research and educational activities that promote understanding of complex living systems at the molecular, subcellular, and cellular levels. The division gives high priority to interdisciplinary research projects that will lead to predictive, quantitative, and theory-based understanding of major biological questions. Research supported by MCB typically combines integrated theoretical and experimental approaches with technologies derived from biological, physical, mathematical, computational, and engineering sciences. Projects are particularly encouraged in emerging areas such as integration across scales from single molecules to cellular complexity, synthetic biology, and genomic basis of phenotypic diversity and properties. The MCB research portfolio also emphasizes projects aimed at understanding and predicting the molecular and cellular foundation of causes and consequences of environmental change. MCB continues to forge partnerships to support research that intersects biology and fields such as physical sciences and engineering, to introduce new analytical and conceptual tools for biological research, and to provide unique education and training opportunities for the next generation of researchers, scientific educators, and scientifically literate citizens.

In general, 39 percent of the MCB portfolio is available for new research grants and 61 percent is available for continuing grants.

FY 2013 Summary

All funding decreases/increases represent change over the FY 2012 Estimate.

Research

- In the FY 2013 Request, there is a general reduction to areas of lower priority to provide resources to other programs related to NSF and directorate priorities.

- MCB will provide support ($4.17 million) for research that addresses the FY 2013 BIO priority in grand challenges at the interface between life and physical sciences. Of particular emphasis are the grand challenges on synthesizing life-like systems and deciphering the genome to phenome relationship.

- In FY 2013, MCB will join the Emerging Frontiers (EF) division in supporting the BioMaPS program, a partnership with the Engineering and Mathematical and Physical Sciences Directorates ($2.28 million). These investments will strengthen research programs in development of new biophysical technologies and computational molecular and cellular biology.

- Because support for early-career researchers is a priority for MCB, the division will increase its investments in CAREER awards (+$610,000 to a total of $13.35 million). This funding is consistent with MCB objectives and contributes to NSF's goal for CAREER award support.

- MCB will contribute $5.0 million (an increase of $2.0 million) to CEMMSS via the National Nanotechnology Initiative, by supporting fundamental research on predictive synthetic biology to design and produce new nanobiomaterials relevant to clean energy, and research on mining of genomic information from diverse biological sources to discover new materials of defined properties.

- MCB will demonstrate global leadership in strategic research technologies of economic importance by investing $3.0 million in collaborative research projects with international partnerships including a nitrogen-fixation Ideas Lab in collaboration with the Biotechnology and Biological Sciences Research Council (UK) and supporting Science across Virtual Institutes (SAVI) projects in synthetic biology, photosynthesis and metabolomics.

- MCB continues to invest in clean energy through support for research on fuel cells, biomass, and the BioMaPS activity.

- MCB will give high priority to research of societal importance, particularly related to economy, energy and environment. Fundamental knowledge about how organisms capture and convert energy will help us develop sources of clean energy. For example, fundamental research funded by MCB on synthesis of peptides on chips has provided the basis for a startup company that is generating peptide chips for diagnostic and other commercial applications.

Education

- In addition to continuing investments in Research Experiences for Teachers (RET) and Research Experiences for Undergraduates (REU) activities, MCB will continue to support educational activities as broader impacts of many research projects funded in the division.

INTEGRATIVE ORGANISMAL SYSTEMS (IOS) $220,520,000 +$8,190,000 / 3.9%

IOS Funding

(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate Amount	Percent
Total, IOS	**$212.56**	**$212.33**	**$220.52**	**$8.19**	**3.9%**
Research	**183.19**	**174.69**	**182.88**	**8.19**	**4.7%**
CAREER	*8.64*	*8.22*	*8.62*	*0.40*	*4.9%*
Education	**2.26**	**1.75**	**1.75**	**-**	**-**
Infrastructure	**27.11**	**35.89**	**35.89**	-	-
Research Resources	*27.11*	*35.89*	*35.89*	-	-

Totals may not add due to rounding.

IOS supports research and education aimed at understanding the diversity of plants, animals, and microorganisms as complex systems interacting with their environments. Reaching a systems level understanding of organisms will require a new emphasis on interdisciplinary approaches and development of new tools. These approaches span computational, molecular, cellular, individual organism, and population levels of inquiry. Many activities supported by IOS focus on biological processes that affect organismal development, structure, performance, and interactions under varying environmental conditions. IOS-supported research focuses on investigating organismal performance in an environmental context, which is significant for understanding reciprocal interactions between the biosphere and drivers of global climate change.

In general, 41 percent of the IOS portfolio is available for new research grants and 59 percent is available for continuing grants.

FY 2013 Summary

All funding decreases/increases represent changes over the FY 2012 Estimate.

Research

- In the FY 2013 Request, there is a general reduction to areas of lower priority to provide resources to other programs related to NSF and directorate priorities.

- In FY 2013, IOS will join the Emerging Frontiers (EF) division in supporting the BioMaPS program, which emphasizes research at the interfaces of biology, engineering, and the mathematical and physical sciences in recognition of its potential value in addressing issues of societal importance ($2.29 million). In FY 2013, IOS will prioritize modeling of multi-scale network integration and function.

- The Basic Research to Enable Agricultural Development (BREAD) Program will continue support for basic research to test innovative, early-concept approaches and technologies for sustainable, science-based solution to problems of agriculture in developing countries. BREAD is jointly supported by NSF ($3.0 million) and the Bill & Melinda Gates Foundation ($3.0 million), through funding provided to NSF.

- IOS will contribute to the FY 2013 research focus on all five of the Grand Challenges in biology ($7.50 million), with an emphasis on basic research directed towards comparative neurobiology and the study of biological mechanisms responsible for complex brain functions. Such mechanisms provide the basis for adaptive responses to changing environments and also drive the evolution of animal behavior.

- International leadership ($3.0 million) will be emphasized through continued support of metabolomics research, the systematic study of all of the molecules in an organism, as well as research on improvements in nitrogen fixation and nitrogen utilization in plants and microbes through the support of a nitrogen fixation Ideas Lab in collaboration with the Biotechnology and Biological Sciences Research Council (UK) and supporting a Science Across Virtual Institutes (SAVI) project in photosynthesis.

- In addition, IOS will maintain its support of research and coordination activities in neuroinformatics. These studies contribute to a greater understanding of organismal structure and function and provide new insights into materials and processes of potential economic value.

- Support for CAREER ($8.62 million total) will be continued in recognition of the importance of supporting junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and integration of education and research activities.

- IOS invests in clean energy through support for research in biomass and also through increased support for the BioMaPS activity.

- Broadening participation will be emphasized across all IOS activities. IOS will have an emphasis on supporting networking efforts focused on increasing participation and retention of underrepresented groups and women in science.

Education

- IOS includes support for Research Experiences for Teachers (RET) and Research Experiences for Undergraduates (REU) activities ($1.75 million).

Infrastructure

- The IOS request includes investments in research resources supported through the Plant Genome Research Program. The Plant Genome Research Program (PGRP) supports genome-scale research to accelerate basic discoveries in basic plant biology as well as downstream applications of potential societal benefit such as crop improvement, development of new sources of bio-based energy, development of sources of novel bio-based materials, and adaptation to global climate change.

DIVISION OF ENVIRONMENTAL BIOLOGY (DEB) $143,730,000 +$1,170,000 / +0.8%

DEB Funding

(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate Amount	Change Over FY 2012 Estimate Percent
Total, DEB	**$142.72**	**$142.56**	**$143.73**	**$1.17**	**0.8%**
Research	**140.43**	**141.06**	**142.23**	**1.17**	**0.8%**
CAREER	*3.66*	*3.43*	*3.60*	*0.17*	*5.0%*
Education	**2.29**	**1.50**	**1.50**	**-**	**-**

Totals may not add due to rounding.

DEB supports catalytic and transformative research to inventory life on earth, to discover life's origins and evolutionary history, and to understand the dynamics of ecological systems. Ecological systems, in turn, provide goods and services that form the foundation of the bioeconomy and its support of human health and welfare (e.g., breathable air, potable water, food and fiber, crop pollination, disease control). Scientific foci in DEB address the process of evolution; describe the genealogical relationships of all life; elucidate the spatial and temporal dynamics of species interactions that govern the assembly of functional communities; and determine the flux of energy and materials through ecosystems. This theoretical and empirical research in ecology, evolution, and biodiversity is enhanced by dynamic interactions with the fields of genomics, computer science, and mathematics.

In general, 46 percent of the DEB portfolio is available for new research grants and 54 percent is available for continuing grants.

FY 2013 Summary

All funding decreases/increases represent change over the FY 2012 Estimate.

Research
An increase to the DEB budget (+$1.17 million to a total of $143.73 million) will support core activities in support of the SEES portfolio and the new BIO 5 grand challenge activity.

- Funds will continue to support innovation in review processes ($1.0 million) that is matched by the innovation activities in Emerging Frontiers.

- DEB will invest in SEES through continued support ($15.0 million) for the Dimensions of Biodiversity program, an activity in its third year of a campaign to identify the scale of global biodiversity.

- $3.0 million of the Dimensions in Biodiversity investment described above will contribute to international leadership by supporting research partnerships with Brazil and China. Projects include such research as how plant and drought defense may help prepare society for future global food security challenges, and prediction of patterns of range shifts and species extinctions through research on the evolutionary capacity of various aquatic and terrestrial organisms to adapt to changing conditions.

- Support for the Assembling the Tree of Life (AToL) program will continue with an every-other-year competition that combines two years of funding into each set of awards. The next competition will be held in FY 2014.

- DEB will participate in the FY 2013 research focus on BIO's five grand challenges. $4.17 million will support DEB programs that address grand challenges of understanding biodiversity and increasing our knowledge of how the biosphere interacts with earth systems such as climate. For example, a new study concludes that some global climate models may be flawed, as they may incorrectly predict releases of atmospheric carbon dioxide because they don't adequately reflect variable temperatures that can affect the amount of carbon released from soil.

- Responding to the national priority of supporting young investigators, DEB support for CAREER increases (+$170,000 thousand to a total of $3.60 million).

Education

- DEB's investment includes support for Research Experiences for Teachers (RET) and Research Experiences for Undergraduates (REU) activities. .

- DEB is funding a distributed graduate seminar as part of a novel effort to integrate education with research while testing a new approach to the assessment of our portfolio of investments in Dimensions of Biodiversity. This seminar is developing a baseline against which research advances supported by this and complementary programs can be assessed.

DIVISION OF BIOLOGICAL INFRASTRUCTURE (DBI)

$129,680,000
+$3,500,000 / 2.8%

DBI Funding
(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate Amount	Percent
Total, DBI	**$129.28**	**$126.18**	**$129.68**	**$3.50**	**2.8%**
Research	**47.08**	**46.13**	**49.78**	**3.65**	**7.9%**
CAREER	*5.40*	*5.14*	*5.44*	*0.30*	*5.8%*
Centers Funding (total)	*39.06*	*42.22*	*42.40*	*0.18*	*0.4%*
Centers for Analysis & Synthesis	*22.94*	*26.12*	*26.30*	*0.18*	*0.7%*
Nanoscale Science & Engineering Centers	*5.12*	*5.10*	*5.10*	-	-
STC: Center for Microbial Oceanography (C-MORE)	*4.00*	*4.00*	*4.00*	-	-
STC: BEACON	*5.00*	*5.00*	*5.00*	-	-
Science of Learning Centers	*2.00*	*2.00*	*2.00*	-	-
Education	**30.71**	**20.50**	**19.00**	**-1.50**	**-7.3%**
Infrastructure	**51.50**	**59.55**	**60.90**	**1.35**	**2.3%**
Nat'l Nanotechnology Infrastructure Network	*0.35*	*0.35*	*0.35*	-	-
Research Resources	*51.15*	*59.20*	*60.55*	*1.35*	*2.3%*

Totals may not add due to rounding.

DBI empowers biological discovery by funding the development and enhancement of biological research resources, human resource activities, and centers. DBI supports the development of, or improvements to, research infrastructure; the development of human capital through support of undergraduate and postdoctoral researchers; and centers and center-like activities that create opportunities to address biological questions that have major societal impact. In addition, BIO's participation in a variety of cross-cutting activities such as Integrative Graduate Education and Research Traineeship program (IGERT) and the Major Research Instrumentation Program (MRI) is managed in DBI.

DBI investments underpin advances in all areas of biological research. Support for research includes development of informatics tools and resources, development of new instrumentation, the curatorial improvement and digitization of research collections, and improvements to research facilities at biological field stations and marine laboratories. Support for education includes research experiences for undergraduates and postdoctoral research fellowships.

In general, 25 percent of the DBI portfolio is available for new research grants and 75 percent is available for continuing grants. Approximately 30 percent of the DBI portfolio is comprised of centers and center-like activities, while the remainder is distributed through grants for various DBI and BIO priorities and continuing funds for grants made in previous years.

FY 2013 Summary

All funding decreases/increases represent change over the FY 2012 Estimate.

Research

- Because DBI investments underpin advances in all areas of biological research, DBI will provide support ($4.17 million) for the FY 2013 focus on projects related to all five of the BIO priority grand challenge questions at the intersection of the life and the physical sciences.

- Funding for the Centers for Analysis and Synthesis increases (+$180,000 to a total of $26.30 million) as part of the planned ramp up for iPlant and the National Institute for Mathematical and Biological Synthesis (NIMBioS).

Education

- Within BIO, some human resource/education programs are centralized within DBI. Support will be sustained across those activities including, IGERT, RET, and REU-Sites (Research Experiences for Undergraduates-Sites) for a total of $19.0 million. The Climate Change Education (CCE) program, supported through DBI, is no longer a part of SEES portfolio, so DBI's investment in CCE will conclude. (-$1.50 million).

Infrastructure

- DBI investments in infrastructure will be increased (+$1.35 million to a total of $60.90 million) to further advances in databases, resources and tools for the entire biology community.

- BIO continues to be active in all aspects of the CIF21 investment, as its components are important to advancement across all of the biological sciences. Increased support (+$2.0 million to a total of $4.0 million) will focus on data-enabled science and the new Software Institutes activities.

- DBI investments in the Collections in Support of Biological Research will not be funded in FY 2013 (-$4.0 million). Support for this program has been moved from an annual to a biennial competition; when competed, the program is funded at $4.0 M. Funds from this reduction will be used to support activities related to the BIO priority investments at the intersection of the life and the physical sciences and in the grand challenges.

EMERGING FRONTIERS (EF)

$107,250,000
+$1,730,000 / 1.6%

EF Funding
(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate Amount	Percent
Total, EF	**$103.79**	**$105.52**	**$107.25**	**$1.73**	**1.6%**
Research	**74.46**	**59.14**	**56.91**	**-2.23**	**-3.8%**
CAREER	*1.62*	*1.60*	*1.62*	*0.02*	*1.3%*
Education	**9.20**	**13.00**	**6.50**	**-6.50**	**-50.0%**
Infrastructure	**20.12**	**33.38**	**43.84**	**10.46**	**31.3%**
Research Resources	*10.45*	*10.45*	*10.45*	*-*	*-*
Facilities Pre-Construction Planning (total)	*9.67*	*7.00*	*3.00*	*-4.00*	*-57.1%*
National Ecological Observatory Network	*9.67*	*15.93*	*30.39*	*14.46*	*90.8%*

Totals may not add due to rounding.

EF is an incubator for new infrastructure and research areas that transcend scientific disciplines and/or advance the conceptual foundations of biology. One such project was the creation of novel bio-films capable of increased solar energy capture and storage by photosynthesis for diversion to more efficient processes.

Typically, new programs and priority areas that begin in EF mature and transition to other BIO divisions to become part of the disciplinary knowledge base. For example, both the Assembling the Tree of Life and Ecology of Infectious Diseases programs began in EF and transitioned to DEB in 2010. Supporting fundamental biological research that crosses scales of organization and engages multiple disciplines continues to be a high priority, and is particularly relevant to strategic research areas such as global change and the intersection of the life and physical sciences. EF also facilitates the development and implementation of new forms of project development and merit review, such as the Ideas Labs, which stimulate imaginative approaches and creative solutions to difficult research questions by promoting new and inventive collaborations across scientific disciplines. EF will continue to explore original mechanisms and investments at the frontiers of biological research, and facilitate support of research relevant to all of biology with targeted co-funding throughout the directorate.

In general, 74 percent of the EF portfolio is available for new research grants. The remaining 26 percent funds continuing grants made in previous years.

FY 2013 Summary

Research

- In the FY 2013 Request, there is a general reduction to areas of lower priority to provide resources to other programs related to NSF and directorate priorities.

- EF will support SEES (+$9.0 million for a total of $19.75 million) through Sustainability Research Networks; SEES fellows; Dynamics of Coupled Natural and Human Systems (CNH); Research Collaboration Networks (RCNs); and through the Dimensions of Biodiversity and Ocean Acidification programs, which are designed to provide an enhanced and integrated understanding of

the natural variation and function of life on Earth, across genetic, taxonomic, and functional dimensions.

- Continued support for research activities relevant to NEON, including MacroSystems Biology (-$5.0 million, to a total of $15.0 million).

- EF will continue to support BioMaPS with $9.0 million.

- EF will support clean energy through investments in BioMaPS and new support for SEES Sustainability Research Networks.

- EF will provide an increase of $2.0 million (to a total of $4.0 million) in support for INSPIRE.

- EF will provide an increase of $1.5 million (to a total of $2.0 million) for I-Corps. In FY 2012, EF made its first I-Corps award, which supported a prototype instrument for an automated high through-put measurement of membrane ion channels in primary cells or sub-cellular organelles not possible with current technology.

- EF will decrease the innovation fund by $9.0 million (to a total of $7.0 million), as some activities have transitioned to the other BIO divisions.

Education

- EF is reducing support for Transforming Undergraduate Biology Education (-$6.50 million to a total of $6.50 million).

- New pilot programs such as Expeditions in Education (E^2) aimed at improving undergraduate STEM education are being developed in partnership with EHR and in response to the recommendations of the "Vision and Change: A Call to Action" conference, supported by the National Science Foundation and the American Association for the Advancement of Science (AAAS) (Report: http://visionandchange.org/files/2010/03/VC_report.pdf)

Infrastructure

- In FY 2013, management and operations funding for NEON will continue to ramp-up as construction moves into year three, with multiple site and domain construction, and cyberinfrastructure development, data products will begin to come on line.

- Funding continues ($10.0 million total) for an activity in support of digitization of scientific information associated with biological specimens held in U.S. research collections. This program was begun in FY 2009 with funding from the American Recovery and Reinvestment Act of 2009 (ARRA). A strategic plan developed by the community and released in FY 2010 will continue to guide investments in FY 2013.

- Funding continues for NEON-related concept and development for advanced tool development ($3.0 million total), as construction continues on NEON. Project development costs will continue as the NEON project transitions into construction and operations; the advanced concept and development will allow for advanced infrastructure development and educational programming for the project.